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AN EVALUATION OF ORGANOCHLORINE PESTICIDE CONTAMINATION  
IN THE TOMBIGBEE RIVER  
NEAR AN INDUSTRY WITH A HISTORY DDT DISCHARGES

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## STUDY OBJECTIVES

This study was designed to provide additional information concerning DDT impacts to the lower Tombigbee River resulting from previous operations at the Ciba Geigy facility at McIntosh, Alabama (Fig. 1). Sediment samples were collected from the river above and below the plant's discharge to determine areas of impact and the extent of downstream contamination. It was anticipated that sediments would provide a good historical record of DDT discharges into the river. Two species of fish, largemouth bass and channel catfish, were also collected at these stations to determine if DDT was bioavailable to endemic river biota and which of these species has the greatest affinity to concentrate DDT.

## STUDY DESIGN

Six stations were established in the Tombigbee River above and below the Ciba Geigy outfall (Fig. 2). Station No. 1 was located 5 miles upstream of the outfall as a baseline station to document area background levels. Stations No. 2 and 3 were immediately below the outfall, with station No. 4 being 5 miles further downstream. Station No. 5 was established 10 miles below the outfall and finally station No. 6 at a point 1 mile above the mouth of the Alabama River and 15 miles below the Ciba Geigy complex.

Composite sediment samples were taken from the right and left banks at each station with the exception of stations No. 2 and 3 where only right bank samples were collected. Particular emphasis was placed on collecting only sediments with high organic content. Sand or gravel bottom material, such as found on the left bank at stations No. 2 and 3, was avoided to the point that if that was the only substrate available the sample was not taken.

A five fish composite of largemouth bass and channel catfish was proposed to be collected at each station. Priority was given to adult individuals with a longer resident time in the river (Table 2). Analyses were run on whole fish samples to provide a better assessment of uptake and availability within the foodchain.

Fish and sediment samples were analyzed of the parent DDT compound as well the metabolites. The results were reported as a single total DDT value in

In addition to DDT analyses, fish and sediment samples were also analyzed for the organochlorine pesticides oxychlordane, heptachlor epoxide, trans-nonachlor, alpha chlordane, cis-

nonachlor, endrin, dieldrin, and trans chlordane, as well as PCB's.

An electrofishing unit was used to collect the fish samples which is quite effective in the upper water column but less so on the bottom, particularly in deeper waters. As a result, the largemouth bass samples were easily collected whereas the five fish composite for channel catfish was not obtainable at all stations (Table 2).

## RESULTS

The ~~highest~~ residue levels reported, ~~5.95 ug/g~~ were found in largemouth bass at station No. 2 in the immediate vicinity of the present Ciba Geigy outfall (Table 1). Channel catfish collected from this same site had much lower levels, 0.50 ug/g, than the bass. This residue uptake correlation persisted throughout the investigation with largemouth bass consistently demonstrating higher DDT levels than channel catfish at a given location.

The second highest DDT concentration, 4.44 ug/g, was found in a largemouth bass sample collected at station No. 5, 10 river miles downstream of the Ciba Geigy outfall. It is interesting that bass collected midway between these two sites, station No. 4, contained the lowest DDT levels reported in the study, 0.49 ug/g. These low values for bass at station No. 4 were corroborated by corresponding low residues in catfish, 0.33 ug/g.

Station No. 1 was established 5 river miles upstream of the Ciba Geigy outfall to document background DDT levels or at least levels that existed above the study area. However, residues in the bass sample, 1.18 ug/g, were higher than two of the three stations downstream from the Ciba Geigy outfall. It would appear that either this value is within the background range for DDT in the lower Tombigbee River or that there could be additional DDT sources in this area. In addition, because of the acknowledged mobility of largemouth bass, there is always the possibility that these fish had recently moved from areas downstream.

With the exception of station No. 2 the levels of DDT in composite sediment samples were consistently low, ranging between 0.17 and 0.21 ug/g. At station No. 2 the highest sediment levels were reported, 1.18 ug/g, which also coincided with the site of highest concentrations found in fish. Otherwise there was little correlation between fish and sediment values.

Of the other organochlorine pesticides analyzed, the highest concentrations found were 0.049 ug/g in fish and 0.05 ug/g in sediments. These are interpreted as trace levels and should pose no potential threat to the environment.

## DISCUSSION

The Fish and Wildlife Service maintains the National Contaminant Biomonitoring Program (NCBP) to document temporal and geographic trends in concentrations of environmental contaminants that may threaten fish and wildlife resources. Fish are collected from 112 stations at key points throughout the United States and in the Great Lakes. One of the monitoring stations is located at McIntosh, Alabama (station No. 14) which coincides with station No. 2 in this study.

Since the NCBP McIntosh station was first activated in 1969 it has reported some of the highest fish total DDT levels in the nationwide network. During 1984, the most recent period in which statistical data is available, DDT levels in fish collected at McIntosh was exceeded by only one network station (Fig.1). This station, on the Yazoo River at Redwood, Mississippi, reported a concentration of 9.08 ug/g in smallmouth buffalo which is only slightly higher than the 8.9 ug/g at McIntosh during this most recent study.

~~one of the most~~  
It has been documented that total DDT residues in excess of 2.0 ug/g in the food chain can be detrimental to consuming organisms. Using this level as a guideline, stations No. 2 and 5 would assure a clearcut danger from DDT contamination.

The United States Drug Administration (USDA) has established a DDT Action Level for the consumption of fish at 5.0 ppm (ug/g). Since this standard applies to edible portions, it is not directly applicable to the data in this study as it was generated from whole fish analyses. However, the magnitude of the DDT residues found in the sample at McIntosh certainly raises a human health concern and an immediate need for a further assessment.

This study confirmed the findings of other investigations that largemouth bass are generally more adapt at assimilating and concentrating DDT than channel catfish. Catfish residues never exceeded 0.73 ug/g which was near the low end of the range found with the bass.

Sediments were particularly disappointing as a tool for assessing historical DDT impacts. They appeared to be insensitive to the variation in concentrations exhibited by the largemouth bass. For example, although residues in bass at stations No. 4 and 5 varied between 0.49 and 4.44 ug/g the sediment levels at these stations only ranged between 0.17 and 0.20 ug/g. The EPA publication, Ambient Water Quality Criteria, has established a bioconcentration factor (BCF) of 17,870 for DDT. This

considerable ability of biota to concentrate DDT could well explain the significantly higher levels found in bass relative to sediments. If only sediment analyses had been available a conclusion could have been reached that, with the exception of station No. 2, DDT levels in the lower Tombigbee River are consistently low and of no particular concern.

#### CONCLUSIONS

1. DDT is concentrated in largemouth bass in the lower Tombigbee River at levels to be detrimental to the food chain.
2. The area of greatest DDT contamination was found adjacent to the Ciba Geigy facility at McIntosh. These levels are of such a magnitude as to pose a potential threat to human consumers of largemouth bass and possibly other species in the area.
3. Channel catfish exhibited far less ability to concentrate DDT than Largemouth bass, particularly in areas of higher ambient concentrations.
4. Sediments were not found to be a good sensitive tool in evaluating sites for DDT contamination, especially at lower concentration levels.
5. Only one of the 112 stations in the U.S. Fish and Wildlife Services National Contaminant Biomonitoring Program was found with DDT levels in fish greater than occurred at the McIntosh station.

#### RECOMMENDATIONS

The data collected in this study indicates that top predator species, i.e., largemouth bass, are effectively concentrating DDT in the lower Tombigbee River near McIntosh, Alabama, at residue levels documented to be harmful to the biota and possibly a threat to the human consumer.

A working group should be convened consisting of the appropriate State and Federal agencies, i.e., ADEM, Game and Fish Division, Alabama Department of Public Health, EPA, and Fish and Wildlife Service. The working group should address three major concerns: the immediate human health threat; an assessment of additional data needs to further evaluate impacts to the lower Tombigbee River environment as well as the human consumer; and the role of EPA's Superfund program in assisting to address these concerns.

It is strongly recommended that the working group be established

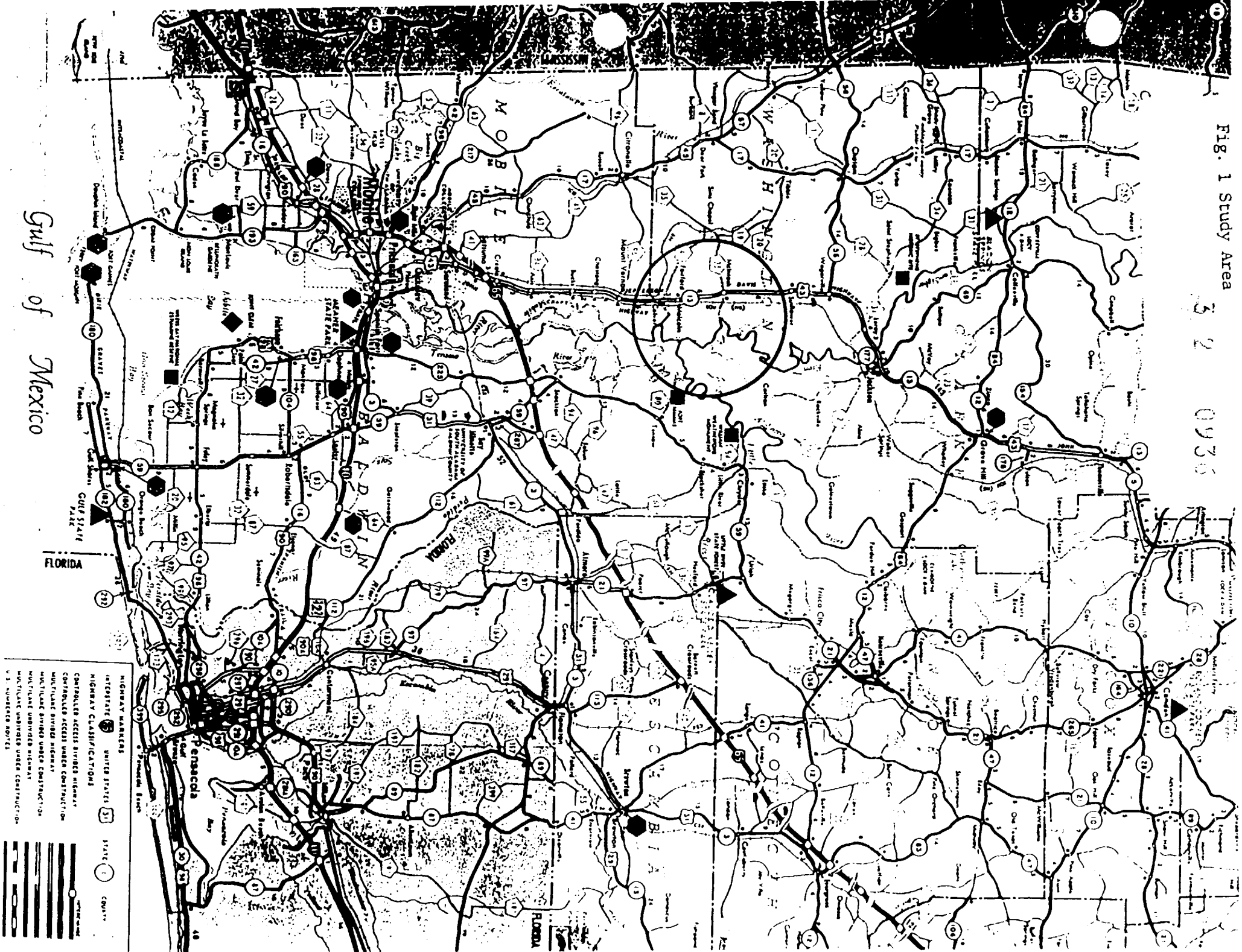
immediately and that a prompt review can be made of any potential health threats and the need for immediate action. It would appear appropriate for the Health Department to assume the lead in evaluating these potential health effects.

The working group should review all available historic data collected from the area in determining a future course of action. If additional investigations are deemed necessary, responsibilities should be delegated with timetables for the completion of specific work elements.

The EPA representative should assume the lead in scoping the role of the Superfund program in supporting these activities. The contaminant of concern, DDT, is suspected to have originated from the Ciba Geigy facility, a National Priority List site currently under CERCA investigation. This would be a timely involvement since EPA is presently evaluating additional data needs necessary for assessing impacts to the environment from this industry.

Fig. 1 Study Area

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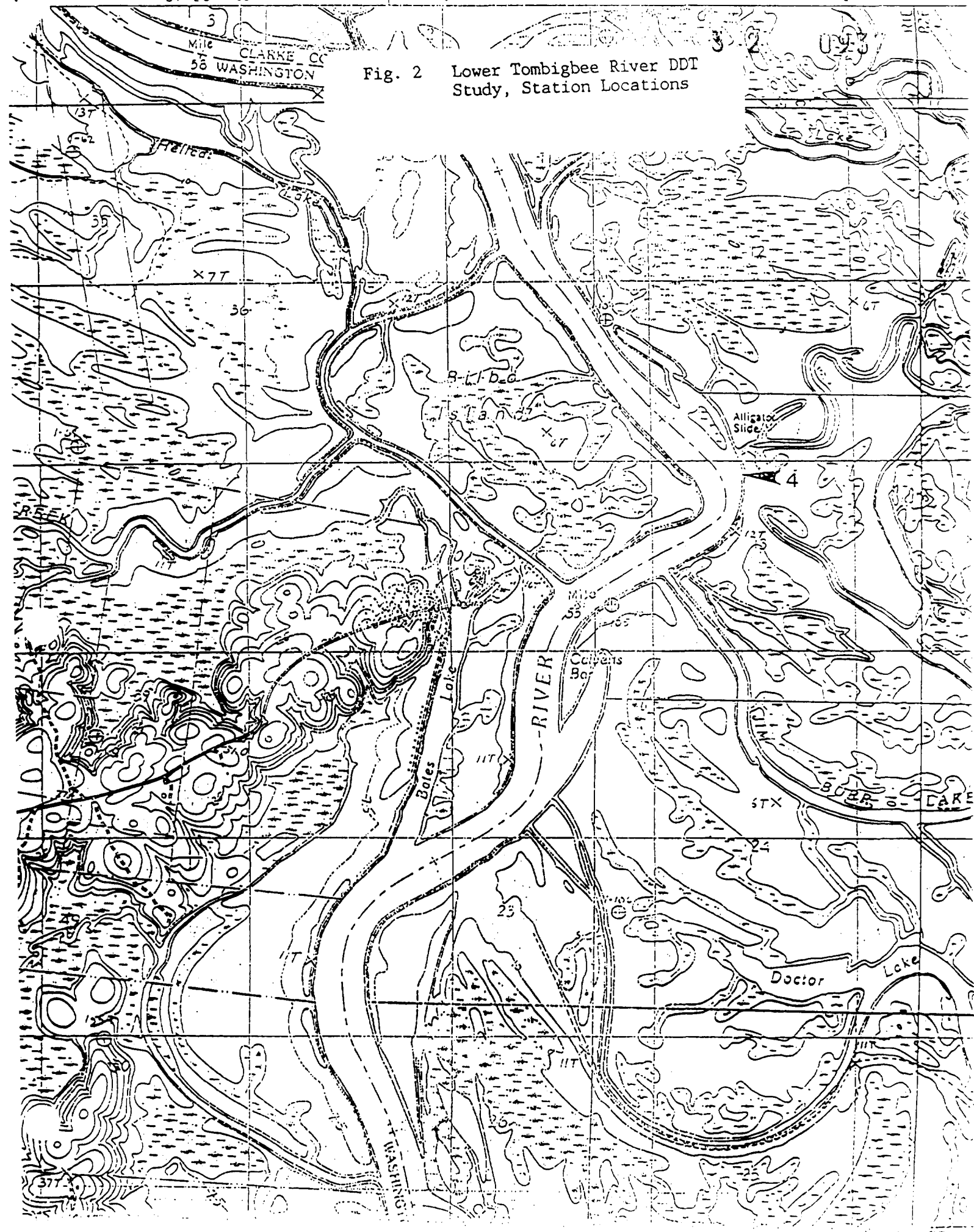




Fig. 2 Lower Tombigbee River DDT Study, Station Locations

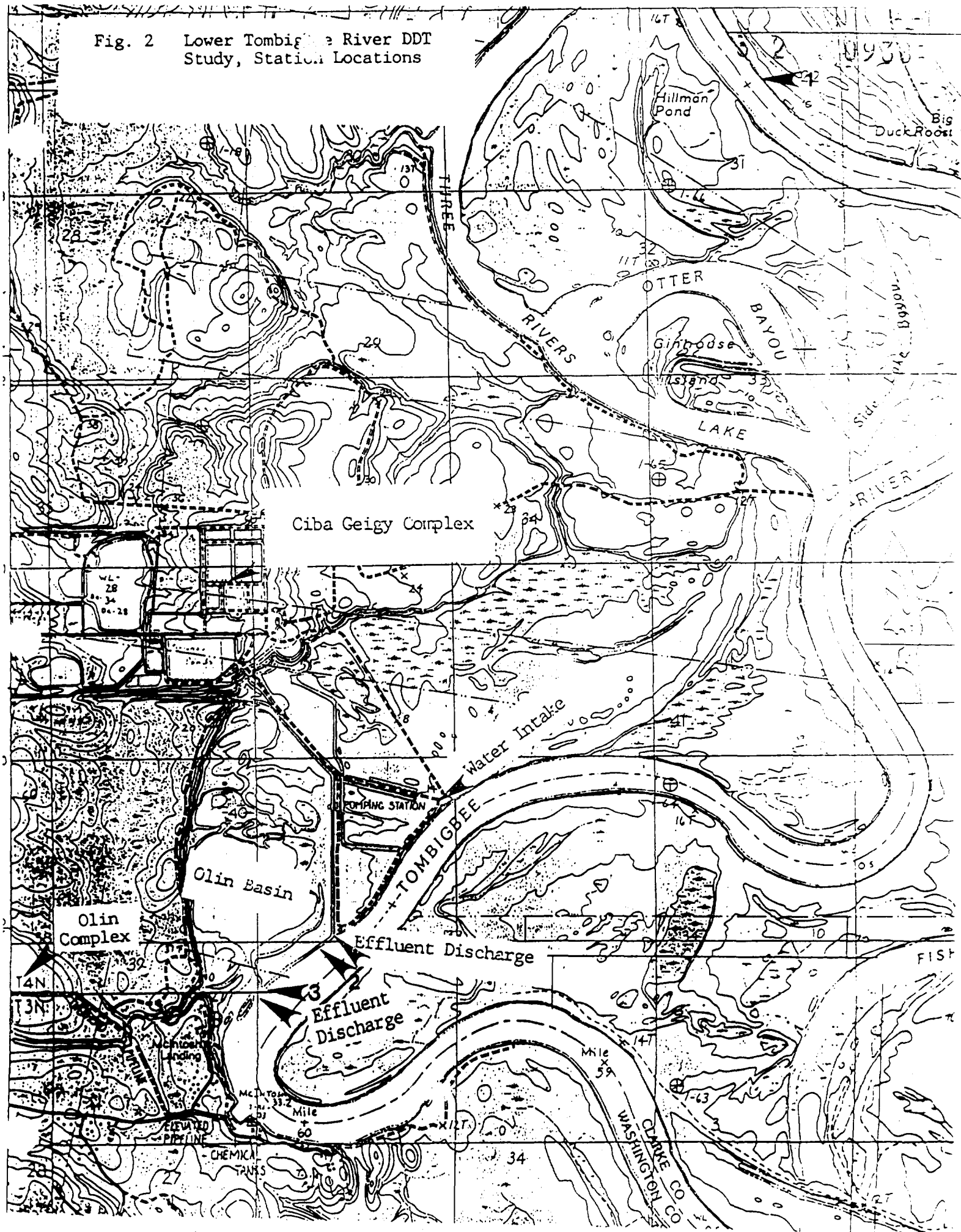


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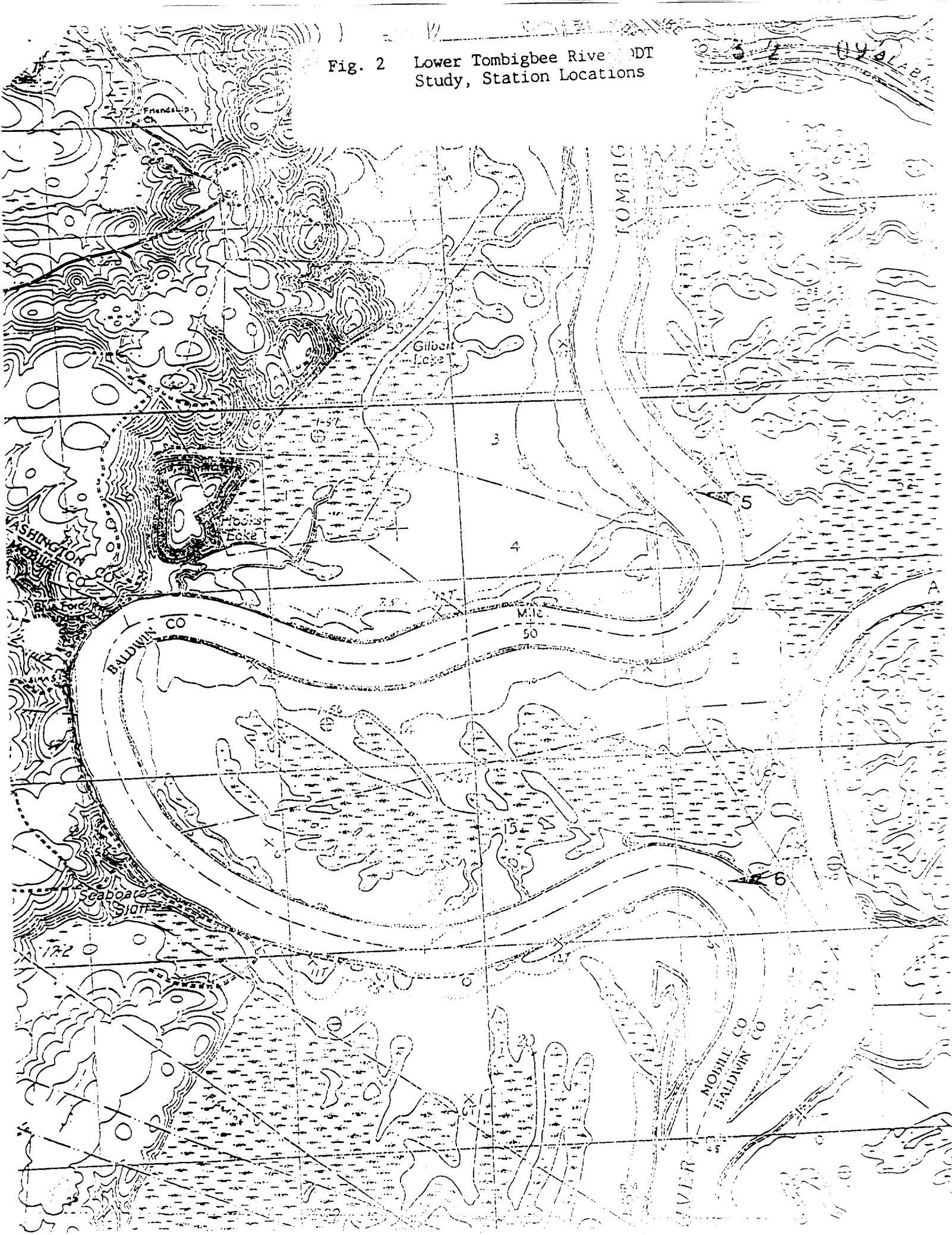


TABLE 1. TOTAL DDT LEVELS IN COMPOSITE FISH AND SEDIMENT SAMPLES COLLECTED FROM THE LOWER TOMBIGBEE RIVER DURING AUGUST AND SEPTEMBER, 1989

SAMPLE NO.	MEDIUM	DDT (ug/g)
		WET WT
STATION NO. 1 - RIVER MILE 66		
DA89-5-1	Largemouth bass, composite (5)	1.18
DA89-5-2	Channel catfish, composite (2)	0.28
DA89-5-3	Sediment, composite - Rt bank	0.17
DA89-5-4	Sediment, composite - Lt bank	0.17
STATION NO. 2 - RIVER MILE 60.8		
DA89-5-5	Largemouth bass, composite (5)	8.9
DA89-5-6	Channel catfish, composite (2)	0.50
DA89-5-7	Sediment, composite - Rt bank	1.18
STATION NO. 3 - RIVER MILE 60.5		
DA89-5-9	Sediment, composite - RT bank	0.21
STATION NO. 4 - RIVER MILE 55.7		
DA89-5-11	Largemouth bass, composite (5)	0.49
DA89-5-12	Channel catfish, composite (5)	0.33
DA89-5-13	Sediment, composite - Lt bank	0.17
DA89-5-14	Sediment, composite - Rt bank	0.20
STATION NO. 5 - RIVER MILE 51		
DA89-5-15	Largemouth bass, composite (5)	4.44
DA89-5-17	Sediment, composite - Rt bank	0.17
DA89-5-18	Sediment, composite - Lt bank	0.17
STATION NO. 6 - RIVER MILE 46		
DA89-5-19	Largemouth bass, composite (5)	0.95
DA89-5-20	Channel catfish, composite (2)	0.73
DA89-5-21	Sediment, composite - Rt bank	0.17
DA89-5-22	Sediment, composite - Lt bank	0.17

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TABLE 2      COMPOSITE SIZE AND WEIGHT OF FISH SAMPLES COLLECTED  
FROM THE LOWER TOMBIGBEE RIVER DURING AUGUST AND  
SEPTEMBER, 1989.

STATION No.	SPECIES	NUMBER IN COMPOSITE	COMPOSITE WT.
1	largemouth bass	5	2500g
1	channel catfish	2	2475g
2	largemouth bass	5	2600g
2	channel catfish	2	2390g
4	largemouth bass	5	2650g
4	channel catfish	5	2600g
5	largemouth bass	5	2700g
6	largemouth bass	5	2500g
6	channel catfish	2	2400g

Table 3.

Geometric mean concentrations of p,p'-DDT homologs for U.S. Fish and Wildlife Service National Contaminant Biomonitoring Program stations at which the mean for total DDT equaled or exceeded the 90th percentile concentration in 1984. Also shown is the national geometric mean for 1984 (x). Station No. 14 is the McIntosh, Alabama site.

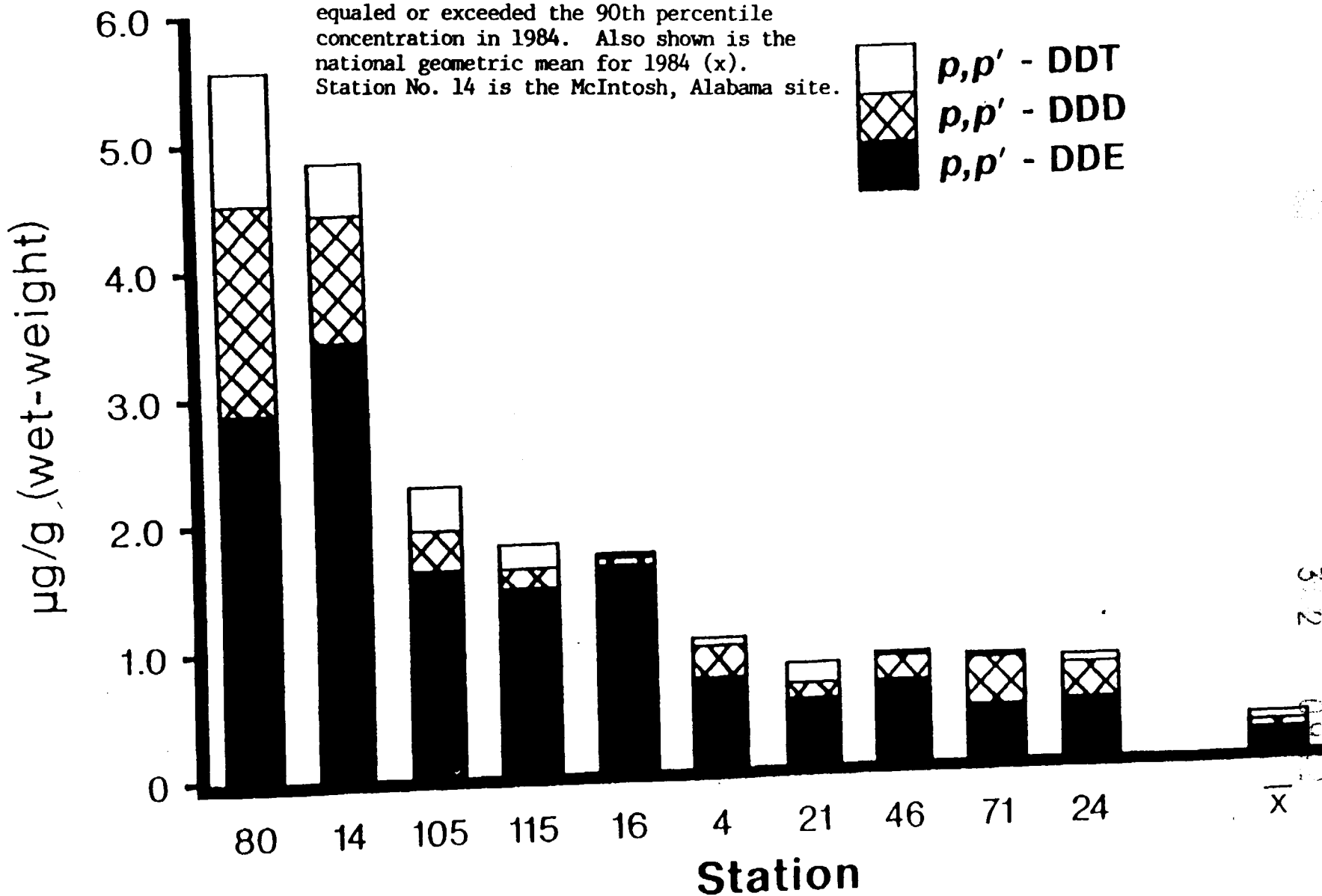


Figure 2 (DDT).